

**College of Micronesia – FSM**  
**P.O. Box 159**  
**Kolonia, Pohnpei**

**Course Outline Cover Page**

**Discrete Devices 1**

Course Title

**VEE 110**

Department and Number

**Course Description:** This course covers the construction and operation of various discrete semiconductor devices and circuits. These devices include diodes, Bipolar Junction Transistors (BJT's) and Field Effect Transistors (FET's). In addition, various configurations of diode half and full wave rectifiers, and bridge rectifiers will be examined as well as ripple voltages and filtering. Zener diode operation, Zener and IC regulation, diode limiter (clipper), clamper and voltage doubler circuits are also analyzed.

**Prepared by:** Gardner Edgar

**State:** Pohnpei Campus

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Lecture	3/6	16/8	48	3
Laboratory				
Total Semester Credits:				3

**Purpose of Course**

Degree Requirement	_____
Degree Elective	_____
Advanced Certificate	_____
Certificate	XX
Remedial	_____
Other (Workshop)	_____

**Prerequisite Course(s):** VEE 104 Electronic Fundamentals II

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**Signature, Chairman, Curriculum Committee**

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**Date Approved by Committee**

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**Signature, President, COM-FSM**

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**Date Approved by the President**

## **General Objective:**

This course will introduce students to the construction and operation of various configurations of single stage amplifiers and diode circuits. It will also provide the students with an introduction to basic single-phase power supplies.

## **Learning Outcomes:**

Upon successful completion of this course the student will be able to:

1. Explain the construction, principle of operation and testing method of semiconductor diodes.
2. Describe the operation and troubleshoot semiconductor diode limiter (clipper) and clamper circuits.
3. Identify BJT schematic symbols and the base, emitter and collector leads. The student will also be able to describe transistor DC bias, transistor cutoff and saturation, and the parameters of Alpha and Beta.
4. Describe the purpose of an amplifier, the classes of operation and identify the three main BJT configurations.
5. Describe the operating characteristics and measure the circuit parameters of the following amplifier types:
  - Common Emitter
  - Common Collector
  - Common Base
6. Recognize FET schematic symbols, describe the construction and operating characteristics of FETs and identify basic FET amplifiers.
7. Describe the operation of common source Junction FET (JFET) amplifiers and verify normal operation through measurement of circuit parameters.
8. Describe typical FET amplifier faults, recognize when a FET amplifier is faulted and identify the faulted component.
9. Recognize Metal Oxide Silicon FET (MOSFET) schematic symbols and describe the construction and operation of Depletion and Enhancement mode MOSFET's.
10. Describe the operation of the following types of rectification
  - Half wave
  - Full wave
  - Bridge
11. Describe the operation of various RC and RL filter circuits.
12. Describe the operation of zener diodes and basic zener voltage regulators.
13. Identify voltage regulator circuits and explain their operation.
14. Describe the purpose and operation of an I.C. Regulator.
15. Explain the operation and advantages of Half and Full Wave Voltage Doublers.

***STUDENTS SHOULD BE MADE AWARE OF OCCUPATIONAL HEALTH AND SAFETY ISSUES IN ALL SITUATIONS AND BE EXPECTED TO DEMONSTRATE SAFE WORKING PRACTICES AT ALL TIMES.***

**Outline of Content:**

- This course contains:
1. Semiconductor Diode
    - N and P type materials
    - P-N junction
      - a. unbiased
      - b. forward biased
      - c. reverse bias
    - silicon and germanium characteristics
    - diode types and specifications
    - terminal identification
    - limiter (clipper), clamper and doubler diode circuits
    - normal operation and troubleshooting
  
  2. Bipolar Junction Transistor
    - NPN and PNP transistor construction
    - NPN and PNP identification
    - NPN and PNP transistor bias
    - Transistor parameters
    - Operating characteristics, circuit configuration, class of operation of:
      - a. Common Emitter Amplifiers
      - b. Common Collector Amplifiers
      - c. Common Base Amplifiers
    - Measurement of input and output waveforms of the three basic amplifier configurations to determine normal operation.
  
  3. Field Effect Transistor
    - The construction and operation of FETs
    - Basic amplifier configurations.

- Measurement of input and output waveforms of the common source amplifier configuration to determine normal operation.
  - Troubleshooting FET amplifier circuits.
4. Metal Oxide Semiconductor FETs (MOSFETs).
    - Construction and operation of both depletion mode and enhancement mode MOSFETs
    - MOSFET applications
  5. Full and Half wave rectifiers
    - basic circuit
    - VAC/VDC relationship
    - Peak inverse voltage
    - Measurement and testing
    - Applications
  6. Bridge rectifier
    - basic circuit
    - VAC/VDC relationship
    - Measurement and testing
    - applications
  7. Filter circuits
    - Use appropriate test equipment to investigate the operating characteristics of the following types of RC and RL filter circuits.
      - a. High pass
      - b. Low pass
  8. Regulators
    - Zener diode characteristics
    - Series and Parallel (Shunt) Zener regulator circuits
    - Voltage Regulator operation and troubleshooting
    - I.C. Regulator operation
    - Series resistor calculations
    - Applications
  9. Fault-finding and trouble shooting
    - Fault-finding and troubleshooting are to be incorporated into all topics in this course and should be a major emphasis

<b>Learning Outcomes:</b>	On completion of this course the learner will be able to:
<b>Learning Outcome 1</b>	<b>Explain the construction, principle of operation and testing method of semiconductor diodes.</b>
Assessment Criteria	<ul style="list-style-type: none"> <li>a. Explain the basic construction and operation of semiconductor diodes.</li> <li>b. Perform simple calculations to select appropriate diodes.</li> <li>c. Use test equipment to test diodes and diode circuits.</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>Multiple choice questions</li> <li>Short answer questions</li> <li>Practical exercises/tests</li> </ul>
<b>Learning Outcome 2</b>	<b>Describe the operation and troubleshoot semiconductor diode limiter (clipper) and clamper circuits.</b>
Assessment Criteria	<ul style="list-style-type: none"> <li>a. Identify two different types of limiter circuit.</li> <li>b. Describe the purpose and operation of diode limiters.</li> <li>c. Identify two different types of clamper circuit.</li> <li>d. Describe the purpose and operation of diode clammers.</li> <li>e. Recognize when a limiter and clamper circuit is faulted and determine the faulty component.</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>Multiple choice questions</li> <li>Short answer questions</li> <li>Practical exercises/tests</li> </ul>
<b>Learning Outcome 3</b>	<b>Identify BJT schematic symbols and the base, emitter and collector leads. The student will also be able to describe transistor DC bias, transistor cutoff and saturation, and the parameters of Alpha and Beta.</b>
Assessment Criteria	<ul style="list-style-type: none"> <li>a. Describe the basic construction of BJTs.</li> <li>d. Describe the purpose of DC bias in transistors and compare the different biasing arrangements for NPN and PNP transistors.</li> <li>e. Describe transistor cutoff, saturation, Alpha and Beta.</li> <li>f. Measure collector current with varying load resistors to observe the transistor parameters of cutoff and saturation.</li> </ul>
Assessment Method	<ul style="list-style-type: none"> <li>Multiple choice questions</li> <li>Short answer questions</li> <li>Practical exercises/tests</li> </ul>

**Learning Outcome 2**      **Describe the purpose of an amplifier, the classes of operation and identify the three main BJT configurations.**

- Assessment Criteria
- a. Describe the purpose of an amplifier.
  - f. Describe classes of amplifier operation.
  - g. Describe common emitter amplifiers.
  - h. Describe common collector amplifiers.
  - i. Describe common base amplifiers.

Assessment Method

Multiple choice questions  
Short answer questions  
Practical exercises/tests

**Learning Outcome 3**      **Describe the operating characteristics and measure the circuit parameters of the following amplifier types:**

- **Common Emitter**
- **Common Collector**
- **Common Base**

- Assessment Criteria
- a. For each amplifier type:
    - Describe the operating characteristics.
    - Describe the purpose of the individual components.
  - b. Determine the class of operation and voltage gain of the common emitter and common base configurations.
  - c. Measure the input and output waveforms of each configuration to determine normal operation and observe circuit waveforms.

Assessment Method

Multiple choice questions  
Short answer questions  
Practical exercises/tests

**Learning Outcome 4**      **Recognize FET schematic symbols, describe the construction and operating characteristics of FETs and identify basic FET amplifiers.**

- Assessment Criteria
- a. Identify FET schematic symbols.
  - b. Describe the construction of FETs.
  - c. Describe the operating characteristics of FETs.
  - d. Identify basic FET amplifier configurations.

Assessment Method

Multiple choice questions

Short answer questions  
Practical exercises/tests

### **Learning Outcome 5**

**Describe the operation of common source Junction FET (JFET) amplifiers and verify normal operation through measurement of circuit parameters.**

Assessment Criteria

- a. Describe the operation of common source FET amplifiers.
- b. Describe the method to check for normal operation of common source FET amplifiers.
- c. Measure the input and output waveforms of a common source FET amplifier.
- d. Recognize normal operation of a common source amplifier.

Assessment Method

Multiple choice questions  
Short answer questions  
Practical exercises/tests

### **Learning Outcome 6**

**Describe typical FET amplifier faults, recognize when a FET amplifier is faulted and identify the faulted component.**

Assessment Criteria

- a. Describe typical faults in FET amplifier circuits.
- b. Describe FET amplifier troubleshooting procedures.
- c. Recognize when a FET amp is faulted.
- d. Identify the faulted component.

Assessment Method

Multiple choice questions  
Short answer questions  
Practical exercises/tests

### **Learning Outcome 7**

**Recognize Metal Oxide Silicon FET (MOSFET) schematic symbols and describe the construction and operation of Depletion and Enhancement mode MOSFET's.**

Assessment Criteria

- a. Recognize MOSFET schematic symbols.
- b. Describe the construction of MOSFET devices.
- c. Describe the operation of Depletion mode MOSFETs.
- d. Describe the operation of Enhancement mode MOSFETs.

Assessment Method

Multiple choice questions  
Short answer questions

**Learning Outcome 3**

**Describe the operation of the following types of rectification**

- **Half wave**
- **Full wave**
- **Bridge**

Assessment Criteria

- a. Describe the purpose of power supplies.
- d. Identify half and full wave rectifiers.
- e. Describe the operating characteristics of half, full and bridge rectifiers.

Assessment Method

Multiple choice questions  
Calculations  
Short answer questions  
Practical exercises/tests

**Learning Outcome 4**

**Describe the operation of various RC and RL filter circuits**

Assessment Criteria

- a. Identify each filter type and state a typical application.
- b. Describe RC and RL filter circuit characteristics.
- c. Compare measured RC and RL circuit values with calculated values.

Assessment Method

Multiple choice questions  
Short answer questions  
Practical exercises/tests

**Learning Outcome 5**

**Describe the operation of zener diodes and basic zener voltage regulators**

Assessment Criteria

- a. Describe zener diode operating characteristics.
- b. Explain the operation of basic zener diode regulators.
- c. Recognize when a zener diode regulator circuit is faulted and observe the effects that faulted components have on the zener regulator circuit.
- d. Recognize when a variable zener diode regulator circuit is faulted and observe the effects that faulted components have on the variable zener regulator circuit.

Assessment Method

Multiple choice questions



Short answer questions  
Practical exercises/tests

**Learning Outcome 6**

**Identify voltage regulator circuits and explain their operation.**

Assessment Criteria

- a. Identify voltage regulator circuits and describe the purpose of the individual regulator components.
- b. Identify faulty voltage regulator operation and determine the faulty component in a faulted variable voltage regulator.

Assessment Method

Multiple choice questions  
Short answer questions  
Practical exercises/tests

**Learning Outcome 7**

**Explain the purpose and operation of an I.C. Regulator.**

Assessment Criteria

- a. Describe the purpose and operation of an I.C. Regulator.
- b. Verify normal operation of an I.C. Regulator.

Assessment Method

Multiple choice questions  
Short answer questions  
Practical exercises/tests

**Learning Outcome 8**

**Explain the operation and advantages of Half and Full Wave Voltage Doublers.**

Assessment Criteria

- a. Identify the purpose of a Voltage Doubler.
- b. Describe the operation and advantages of Half and Full Wave Voltage Doublers.
- c. Identify normal operation of Half and Full Wave Voltage Doublers.
- f. Observe the effect of loading on a Voltage Doubler's output.
- g. Observe the effect of adding additional filter capacitance to a Voltage Doubler.

**Required Course Materials:**

**1. Instructor:**

- a. CAI Classroom with whiteboard or chalkboard
- b. Laboratory equipment with tools of the trade
- c. Text, Teacher's Resource Guide, workbook
- d. Overhead projector, transparencies

**2. Student:**

- a. Text(s), handouts provided by instructor
- b. Ring binder
- c. College ruled note sheet, pencil or pen
- d. Scientific calculator

**Reference Materials:**

Electronic Devices, *Fourth Edition*  
Thomas L. Floyd, 2002

**Method of Instruction:**

1. Computer Aided Instruction
2. Practical/Experimentation
3. Lecture/Demonstration

**Evaluation:**

Final Grade for this course will be based on meeting the course requirements at the following percentage rates:

90% - 100%	A – Superior
80% - 89%	B – Above Average
70% - 79%	C – Average
60% - 69%	D – Below Average
0 % - 59%	F – Failure

**Attendance:**

The COM-FSM attendance policy will apply